CHAPTER 9
LOW-VOLTAGE SYSTEMS

9–1. Interior low-voltage work

There are additional devices for which facility workers must have qualified training to safely maintain low-voltage systems.

a. Applicability. The same safety background requirements covered in chapters 5 and 8 should be applied. Only electrical workers who are familiar with the NEC and have experience on low-voltage circuits are qualified for the job. Only in an emergency, such as loads requiring continuous electric power, may a worker be allowed to work energized circuits; but only with appropriate personnel protective apparel and the presence of another worker or helper.

b. Associated guidance. The worker should also be familiar with the following standards and pertinent facility maintenance manuals: TM 5-683/NAVFAC MO-116/AFJMAN 32-1083, chapter 12; TM 5-685/NAVFAC MO-912, appendix E.

9–2. Low-voltage safety background

The same safety background requirements given in chapter 8 apply. In most cases complex controls or special equipment will be maintained by contract personnel or specially trained facility workers, otherwise, observe the precautions set forth in this chapter. As a part of their qualified training in safely maintaining low-voltage systems, workers will also be familiar with the following requirements.

a. Battery rooms. Be familiar with storage battery safety rules given in paragraph 5–13. In addition, ensure that the following conditions are met before any work is done:

(1) Check that there is adequate ventilation, forced or natural, to prevent buildup of explosive mixtures.

(2) Check that warning signs are securely attached and in legible condition.

(3) Check that eyewash apparatus is in operable condition. If none is permanently installed provide temporary eyewash apparatus.

(4) Verify that cell ventilation openings are unobstructed.

b. Fire alarm systems. Maintaining fire alarm systems with their appropriate safety requirements requires special training. Workers must have the following or equivalent training:

Factory trained and certified.

(2) National Institute for Certification in Engineering Technologies Fire Alarm certified.

(3) International Municipal Signaling Association Fire Alarm certified.

(4) Certified by State or local authority.

(5) Trained and qualified personnel by an organization listed by a national testing laboratory for the servicing of fire alarm system.

c. Motors and generators. For maximum safety, each motor and generator should be of the type and size required for the load and for the conditions under which it must operate. See paragraph 8–3.

(1) After work has been performed on circuits to rotating machines, check direction of rotation.

(2) Always take positive steps to ensure that rotating equipment being repaired cannot be set into motion.

(3) A megohmmeter (megger) can be used to check insulation of motor and generating windings using a current of high voltage and low amperage. Never start a megohm test if there is nay external voltage in the test circuit.

d. Solid-state equipment. Variable frequency motor controllers and uninterruptible power supply (UPS) equipment are complex solid-state devices which should generally be maintained by manufacturer's personnel on a contract basis. Facility personnel are not normally trained for such work. Even with initial training, maintenance work is usually done on such an infrequent basis that subsequently workers cannot be considered fully qualified. Such installations should contain adequate precautionary labeling warning workers of the electric shock dangers involved in operating and maintenance of such equipment.

9–3. Review of low-voltage work precautions

Personnel should assume that all parts of electric circuits are energized. Workers must personally inspect circuits before starting work for assurance that circuits are de-energized or that they can be safely worked on while energized.

a. Repair work rules. Whenever possible, circuits operating at less than 300 volts between conductors will be de-energized before repair work is begun.

(1) No work will be performed on energized interior electrical circuits or equipment operating at more than 300 volts between conductors.

(a) The supply or line side of switches or fuses can be energized when all work to be performed on the load side of such switches or fuses, provides sufficient clearance between energized and de-energized parts so that work can be done safely.

(b) Before beginning work on de-energized circuits or equipment, a reliable voltage detector must be used. Where considerable work is to be performed, it is good practice to short-circuit and ground circuits or equipment.

(c) Approved testing may be performed on energized interior electric circuits or equipment operating at more than 300 volts between conductors.

(2) When working on or near energized circuits, workers must stand on a dry surface, other than cement or masonry, or wear electrician's rubber footwear.

(3) When using fish tape near energized parts, cover live parts with rubber protective equipment.

(4) When working near running machinery, use extreme care, and provide barricades where necessary.

(5) Place all tools clear of machinery before starting machinery. Never use a wrench on running machinery.

(6) Provide adequate illumination.

(7) Use extreme care when working in cramped places to avoid injury to your head, arms, and other parts of your body.

(8) Wear goggles hen soldering larger joints or tinning lugs on connectors.

(9) Remove tripping hazards.

(10) Do not work on slippery surfaces.

(11) All electrical apparatus requiring frequent attention must be capable of being completely isolated electrically.

(12) Provide ventilation, particularly where obnoxious fumes are present. Take particular precautions if explosive or toxic vapors are present or suspected.

(13) Never use flame in any form until satisfied that explosive vapors are not present.

(14) Use extreme care when using torches to avoid igniting combustible material. Never leave torches unattended.

b. Installation. Proper selection and installation of electrical equipment will help to prevent accidents.

(1) Each worker should become familiar with the applicable electrical codes and standards. The foreman must be notified when equipment does not meet the requirements of these codes and standards.

(2) All electrical equipment should be installed to provide adequate working space in accordance with the NEC and local codes. Install equipment so that the possibility of accidental contact with energized conductors is reduced to a minimum.

(a) Tape or cover bare or exposed places on one energized conductor before exposing another energized conductor.

(b) Never leave joints or loose ends of wire untapped or otherwise unprotected.

(3) Equipment should be installed in the less congested areas of a plant, in special rooms, or be provided with suitable guards or barriers.

(4) Warning signs should be displayed near exposed current-carrying parts and in hazardous areas such as medium-voltage installations.

c. Switches. An open knife switch is hazardous because of the exposure of live parts and because of the arc formed when the switch is opened. Such switches should be enclosed in grounded metal cabinets having the control lever operable from outside the cabinet.

(1) A knife switch should be mounted so that

the blades are dead when the switch is open, and should be installed so that gravity will not tend to close the switch.

(2) Double-throw switches should be mounted horizontally so that their operation will not be affected by gravity. Double-throw switches installed vertically will be provided with a locking device to hold moveable blades in the correct position.

d. Fuses and circuit breakers. Fuses or other overcurrent devices should be provided according to the NEC and should be of a size and type that will interrupt the current flow when it exceeds the capacity of the conductor.

(1) Substitution of copper wires or other conductors for fuses will not be permitted.

(2) When it is necessary to remove a cartridge fuse, the operating switch, if provided, should be opened to remove the load. Take fuses entirely out of holders when removing them from circuits. The fuse should be pulled only with an insulated fuse puller. On circuits 300 to 600 volts, use both fuse tongs and rubbed gloves.

e. Control equipment. The space behind the switchboard should not be used for storage and should be kept clear of rubbish.

(1) Good illumination should be provided for the front and rear of switchboards.

(2) Switchboard framework and metal parts of guards should be grounded according to the NEC.

(3) connections, wiring, and equipment of switchboards should be arranged in an orderly manner. Switches, fuses, and circuit breakers should be plainly marked, labeled, or arranged to afford ready identification of the circuits or equipment supplied through them.

f. Grounding. Low-voltage electrical accidents are most frequently caused by a failure to understand the hazards of low-voltage wiring. By far the most misunderstood subject is the “theory of grounding.”

(1) Each worker should carefully study and understand the grounding requirements of the NEC.

(2) Use properly grounded portable electric tools, particularly in damp locations or near grounded equipment or piping.

(3) Do not open a ground connection to a water pipe or ground rod until the ground wire has been disconnected at the equipment.